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if you will refer to observations I long since made and published, you will find as strong a confirmation of your happy suggestion as you can desire, or are likely to receive from future observations, except under circumstances of rare occurrence. In the *Monthly Notices* for Jan. 1851, page 52, you will find I have said, 'I have always observed that the upper (southern) and more distant portion of the obscure ring is more plainly seen than the corresponding portion on the side nearest to the earth, and also that the projection of it at its minor (misprinted *inner*) axis is considerably narrower than accords with its breadth at the major axis.' In writing at the same time to the *Astron. Nachrich.* (see No. 751), after stating as above, I have added, 'To avoid the irradiation in diminishing its (the projection's) apparent breadth, I have carefully examined this dark line in daylight, and strong twilight, when the air was quiet and the image sharply defined. By comparison of its breadth with that of a spider's-web of the micrometer, I concluded it to be not more than from 0″·2 to 0″·25 at the minor axis, which, for the time of observation, corresponds to a breadth of from 1″·08 1″·35 at the major axis, instead of nearly 2″ as I had measured it. The appearances would be satisfied by supposing that a section of the obscure ring may be somewhat *wedge-shaped*, the thicker edge being outwards, and that a section of the bright ring may also be wedge-shaped, its thickest edge being inwards.

"But all this bears directly on your supposition that the obscure ring is not in the same plane as the others; and the observations are better satisfied by it than by any other hypothesis.* That the projection on the ball is not seen as broad as it ought to be I have always observed, and mentioned it in my last paper with reference to your diagrams of *Saturn*, in which the projection required to be *narrowed* to agree with the view my telescope gives me; and in the beginning of 1851 the difference appeared much greater than it does now, which would agree with your suggestion. I did not, indeed, notice that the *southern* part of the faint ring *encroached* on the *inner edge* of the *bright ring*. But in every other respect nothing could more fully support your hypothesis than the observations which I have uniformly made. Some other things strike me about it, which I have no time to mention now, being obliged to conclude hastily.

"Yours truly,
"W. R. Dawes."

"*Wateringbury, Nov.* 29, 1852."

Second Letter from Rev. W. R. Dawes to Mr. De La Rue.

"While I was writing to you yesterday, it occurred to me that in 1848, while the ring of *Saturn* was invisible, I had observed *two*

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* Mr. De la Rue states, that this hypothesis is founded on his observations of the *encroachment* of the dark ring on the southern portion of the inner bright ring and its apparent *contraction* on the opposite side; also on the circumstance of the apparent ellipticity of the dark ring not being the same as that of the bright rings.

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dark lines crossing the equatoreal region, one darker than the other, and separated by an exceedingly fine bright line. I had at that time explained the appearance by the supposition that the *lighter* of these two lines was the *projection of the rings* on the planet, and the *darker* their shadow. (See *Monthly Notices*, vol. x. p. 48, under dates Oct. 6, 26, 30; and Nov. 21; and Remark 3, at the end of my paper). It struck me as possible that your suggestion might afford a different explanation of the appearance, and thereby gain additional support to itself. On referring to my observations at that epoch, and considering the relative positions of the sun, the earth, and the planet, and also how the faint ring must have lain at the time with reference to the other rings on your hypothesis, I find that the explanation I gave at the time must have been the true one, and that the faint ring must have been *enveloped in the shadow* of the others, if its plane deviates as you suppose.

"I recollected also a figure of *Saturn* at the same epoch, by Julius Schmidt, of the Observatory of Bonn, in which are shown two similar dark lines to those I described as observed by myself. (See *Astron. Nachrich.*, No 650, and illustrative lithograph, fig. 17). But the same explanation applies to that which applies to my own; so that this support to your hypothesis fails. Nothing, however, arises from this *in opposition to it*; as, even supposing your idea to be correct, the faint ring must then have been simply invisible.

"From Mr. Johnson's measurements of the equatoreal and polar diameters I deduce

$$e = 0{\cdot}09940 = \frac{1}{10{\cdot}06}$$

as an approximate result, omitting the reduction of the polar diameter measured to the true semi-minor axis.

"In like manner, from your measures, we have

$$e = 0{\cdot}08139 = \frac{1}{12{\cdot}29}$$

"Both of these results are considerably less than that deduced by Mr. Main in 1848, viz.

$$e = 0{\cdot}10838 = \frac{1}{9{\cdot}227}$$

"I suspect that, without great caution, the polar diameter may be *squeezed too close* in the double-image micrometer and in the heliometer. The *brightness* of the poles is so much less than that of the equator, that, without special precautions, the measurements of the polar diameter will almost certainly be taken too small. Those with the P. W. micrometer are not quite free from the same danger, for the inflexion of light at the webs is much more obvious at the bright edges of the equator than at the dull polar limbs, and the *irradiation*, too, will be greater for the same reason. I, therefore, *greatly doubt* whether the ellipticity be anything like what Mr. Main deduced. Draw out such an ellipse, and I think you

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will say you never saw *Saturn* of that figure. And the eye may sometimes be trusted rather than the micrometer. Recollect, too, that the ellipticity of *Jupiter* deduced from the Greenwich observations from 1840–1848, is little more than *half* what Mr. Mr. Main's observations assign to *Saturn*, viz. $\frac{1}{17 \cdot 9}$.

" *Wateringbury, Nov.* 30, 1852."

Sur les Dimensions de Saturne, par M. Otto Struve.

(*Extrait des Mém. Acad. Scien. St. Pétersbourg*, tom. v.)

In this memoir M. Struve has given the results of a limited series of micrometrical measures of *Saturn* and his rings, which he executed at Pulkowa with the great refractor in the autumn of the year 1851. He also examines some observations of preceding astronomers, tending to throw light upon the physical constitution of the rings.

The obscure ring was very distinctly visible on these occasions. M. Struve perceived that at the extremities of the *ansæ* it was divided into two parts by a dark line. He is of opinion that the division extends throughout the entire circuit of the ring. The gradation of light from the ancient bright rings to the obscure ring was very abrupt and striking; but he was unable to discover the slightest trace of a division between the exterior edge of the obscure ring and the interior edge of the inner bright ring. The breadth which he assigns to the obscure ring (2″·035), agrees almost exactly with that which Dr. Galle, of Berlin, obtained in 1838, and with a similar measurement of Mr. Dawes in 1851. (*Monthly Notices*, vol. xi. p. 52.)

M. Struve next proceeds to show that the observations of various astronomers anterior to the year 1838, afford unequivocal indications of the existence of the obscure ring. He remarks that the early observers generally make mention of a dark belt (termed the equatoreal belt) which was seen passing across the body of the planet *immediately contiguous* to the inner edge of the interior bright ring. J. Cassini showed in 1715, that from its slight curvature the equatoreal belt could not be situate close to the surface of the planet. The observations of Hadley, a few years later, would seem to establish almost beyond doubt the identity of the equatoreal belt with the obscure ring of modern astronomers. In 1723 he remarked that the dusky line which in 1720 he observed to accompany the inner edge of the ring across the disc, *continued close to the same, though the breadth of the ellipse had considerably increased since that time.* (*Phil. Trans.* 1723, No. 378.) He asserts, moreover, in reference to the hypothesis of the belt being produced by the shadow of the ring upon the planet, that when he considered the situation of the sun with respect to the ring and the planet, he found that the belt could not arise from such a cause.